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Memo

date: *January 3, 2002*

to: *N. Gmur*

from: *C. Weilandics* 1/22/02

subject: *Bldg. 725 RF Equipment Survey*

This memo will summarize non-ionizing radiation(RF) surveys conducted in the NSLS complex.

On Jan. 12 , 2001, a partial RF survey was conducted by myself in Bldg. 725; in attendance was R. D' Alsace of the NSLS RF group. The purpose was to get a general overview of the status of potential for exposures to RF in Bldg. 725 from the high power RF equipment in use. Measurements were made on the following equipment summarized in the table I below:

1. Booster RF power amplifiers, idle and ramping, 52.8 MHz
2. VUV RF power amplifiers, powered, 211 MHz, stored beam
3. X-ray ring RF power amplifiers, 52.8 MHz, stored beam
   a) 100 watt amplifiers
   b) 3 kW power amplifiers
   c) 125 kW power amplifiers

For these measurements, electric(E) field surveys were conducted using a calibrated(Mar. 9, 2000) Holaday HI-3002 broadband exposure meter. The E field probe used was capable of measuring RF over the frequency ranges of 0.5 MHz to 6000 MHz. The minimum resolution on the instrument was 0.13 mW/cm^2. Measurements were taken around the cabinets housing the equipment, specifically at the panel joints where one might expect some leakage. Also surveyed were the accessible portions of the RF cables and their connections, and waveguide connection points and joints. Measurements were essentially at "contact", or as close the areas as the probe head cover would allow. The 10 cm diameter Styrofoam probe head cover actually allows access no closer than about 4-5 cm.

On August 10 and 29, 2001, the 2856 MHz RF systems for the NSLS Linac were surveyed. These included the nominal 1 watt and 1kW signal drive for the first klystron. housed in cabinet SR15 near the LINAC gun, as well as the drive signals for each of the other two klystrons feeding off of the splitter from the #1 klystron waveguide. In addition, the waveguide feeds from klystrons 1,2 and 3 into their respective Linac tanks up to their wall penetrations into the linac cave during VUV ring injection were measured. On Sept. 7, 2001, the 100W amplifiers for the Xray and VUV feedback systems were measured, as well as the LINAC RF systems for the ATF and SDL including the 2856 MHz RF systems for the

klystrons A, B, and C. In all cases measurements were on the order of less than 1% of the standard.

For this group of measurements, electric(E) field surveys were conducted using a calibrated Narda(Model 8718B, s/n6036) RF survey meter. The E field probe used(model 8722D, sn02007) was capable of measuring RF over the frequency ranges of 300 kHz to 50 GHz. The minimum resolution on the instrument was 0.3% of the standard. Measurements were taken around the cabinets housing the equipment, specifically at the panel joints where one might expect some leakage. Also surveyed were the accessible portions of the RF cables and their connections, and waveguide connection points and joints. Measurements were essentially at about 5-10 cm away from the edge of the probe . The 10 cm diameter probe head cover actually allows access no closer than about 4-5 cm.

Results

For the 01/12/01 measurements, in general, we found no measurable RF from any of the systems with three exceptions. On the system XRF1 125 kW amplifier, at approximately the seven and nine o'clock positions of the main front panel, we were able to measure about 0.13 mW/cm^2, or about 13% of the standard. The level dropped off so as to be unmeasurable when the probe head was moved away one to two inches. The only other location where a measurable level could be seen was about 0.2 mW/cm^2, or about 20% of the standard at "contact" on a waveguide coupling in back of the XRF4 125 kW system cabinet. This again was highly localized. The three measurement point are indicated in Figures 1 an 2 with gray filled circles. In all of the other surveys(2856 MHz), we found no appreciable RF from any of the systems. These measurements showed levels routinely below 1% of the standard(approx. $10mW/cm^2$) for the 2856MHz measurements.

Discussion

The standard for exposure to non-ionizing radiation which BNL has referenced is the IEEE C95.1-1991 standard also referenced by ACGIH. In all cases the electric field strength levels measured were well below the standard of 1 mW/cm^2. In ACGIH's notice of intended changes, induced and contact body current measurements are to be made if the electric field strength levels are above 18% (for the 52.8 and 211 MHz frequencies)of the TLV. In our case this was not exceeded. However, as stated above, these levels do not pose whole body exposures, and in no case was the Threshold Limit Value exceeded. The general TLVs for RF and microwaves are not expected to change. Based on this preliminary set of measurements, measured magnetic(H) fields are not expected to be significant, or in most cases measurable.

Figure 1: XRF1 125 kW amplifier

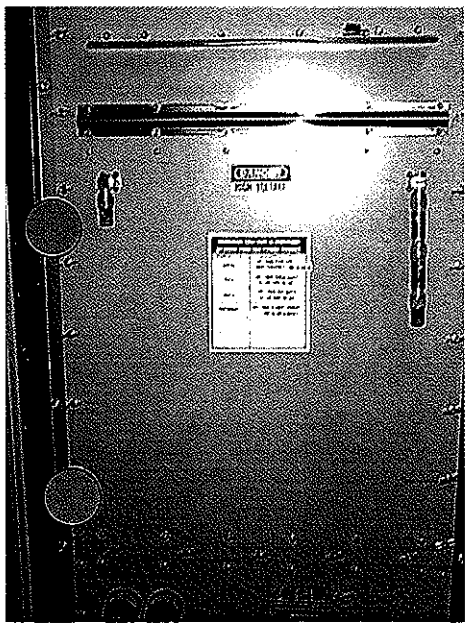

Figure 2: XRF4 125 kW system waveguide coupling

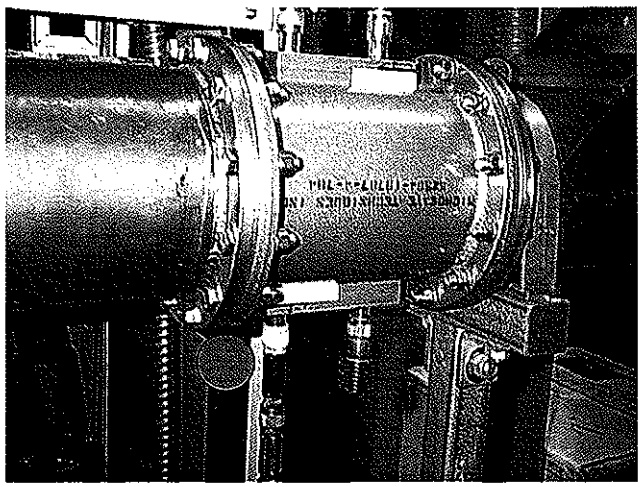

Table I: RF systems measured and conditions of measurement

Number	System Name	Power Rating	Fwd. Pwr.	Rev. Pwr.	Cavity Fld.	Notes
1	XRF1	125 kW	72 kW	7 kW	33.5 kW	240-248mA, 2.8 GeV
2	XRF1	3 kW	3 kW			240-248mA, 2.8 GeV
3	XRF1	100 W	70 W			240-248mA, 2.8 GeV
4	XRF2A	125 kW	66 kW	1 kW	45 kW	240-248mA, 2.8 GeV
5	XRF2A	3 kW	1.5 kW			240-248mA, 2.8 GeV
6	XRF2A	100 W	40 W			240-248mA, 2.8 GeV
7	XRF2B	125 kW	64 kW	1 kW	45 kW	240-248mA, 2.8 GeV
8	XRF2B	3 kW	1.5 kW			240-248mA, 2.8 GeV
9	XRF2B	100 W	40 W			240-248mA, 2.8 GeV
10	XRF3	125 kW	79 kW	8 kW	37 kW	240-248mA, 2.8 GeV
11	XRF3	3 kW	2 kW est.			240-248mA, 2.8 GeV
12	XRF3	100 W	50 W			240-248mA, 2.8 GeV
13	XRF4	125 kW	79 kW	8 kW	37 kW	240-248mA, 2.8 GeV
14	XRF4	3 kW	2 kW (est.)			240-248mA, 2.8 GeV
15	XRF4	100 W	50 W (est.)			240-248mA, 2.8 GeV
16	VUVRF1	50 kW	8 kW	2 kW	3 kW	67 mA, 800MeV
17	VUVRF1	3 kW	200 W			67 mA, 800MeV
18	VUVRF1	100 W	5 W			67 mA, 800MeV
19	VUVRF2	10 kW	590 W	20 W	630 W	67 mA, 800MeV
20	VUVRF2	10 W	1W			67 mA, 800MeV
21	Booster RF	3 kW				"Front porch"
22	Booster RF	3 kW				Ramping
23	Booster RF	100 W				"Front porch"
24	Booster RF	100 W				Ramping

Table II: RF systems measured and conditions of measurement

Equip. Name	Manuf.	Model #	Serial #	Freq.	Oper. Pwr.	Room/Area
Klystron	Triton	8568	1109	2856MHz	15MWpk	725/LINAC
Klystron	Triton	8568	1110	2856MHz	15MWpk	725/LINAC
Klystron	RCA	4670	Y146	2856MHz	15MWpk	725/LINAC
Klystron	ITT	8568	1049	2856MHz	15MWpk	725/LINAC
Amplifier	MICON	Q7JAY	2302X	2856MHz	800Wpk	725/LINAC
Amplifier	MICON	Q7JAY	2067	2856MHz	800Wpk	725/LINAC
Klystron	RCA	4670	K114	2856MHz	15MWpk	ATF
Klystron	Triton	8840	3015	2856MHz	15MWpk	ATF
Amplifier	MICON	Q7JAY	3080	2856MHz	400Wpk	ATF
Amplifier	ProComm	3000S-2K	94101	2856MHz	400Wpk	ATF
Amplifier	ENI	5100L	480	300MHz	100W	725/VUV
Amplifier	ENI	5100L	624	300MHz	100W	725/VUV
Amplifier	ENI	5100L	472	300MHz	100W	725/VUV
Amplifier	ENI	5100L	479	300MHz	100W	725/VUV
Amplifier	ENI	5100L	191	300MHz	100W	725/X-ray
Amplifier	ENI	5100L	194	300MHz	100W	725/X-ray
Amplifier	ENI	5100L	196	300MHz	100W	725/X-ray
Amplifier	ENI	5100L	198	300MHz	100W	725/X-ray
Klystron	RCA	4670	K114	2856MHz	15MWpk	SDL
Klystron	RCA	4670	K114	2856MHz	15MWpk	SDL
Klystron	RCA	4670	K114	2856MHz	15MWpk	SDL
Amplifier	Thomson	TH218A	128003	2856MHz	250Wpk	SDL
Amplifier	Thomson	TH218A	128014	2856MHz	250Wpk	SDL
Amplifier	Thomson	TH218A	128007	2856MHz	250Wpk	SDL

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